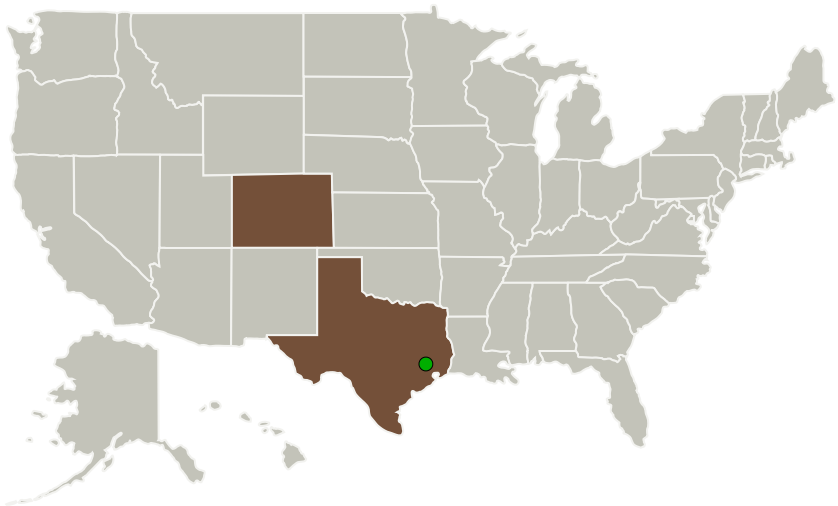
Polyethylene Production from In-Situ Resources in Microchannel Reactors, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

According to NASA, it costs $10,000 to move a pound of material from earth into orbit, and 10 to 40 times more to movie to the Moon and Mars. Instead of paying to move each spare part, structure support, radiation shield and utensil (along with a wide range of other products) from Earth to Mars extraterrestrial in-situ resources (sunlight, CO2 and H2O) can be converted into polyethylene. A wide range of products including water bottles, thin films, bags, high pressure pipe and at almost any shape could be produced using additive manufacturing. Polyethylene is also a candidate for radiation shielding due to its high hydrogen content. TDA Research, Inc. (TDA) proposes to develop a plastics manufacturing plant via in situ resource utilization. The plant consists of (1) a solar powered gas generation system to produce CO and H2 from indigenous CO2 and H2O, (2) a micro-channel olefin synthesis reactor that converts the synthesis gas (CO and H2) to light olefins, (3) a polyethylene synthesis reactor, (4) a reformer for processing unreacted gases and by-products back into more synthesis gas feedstock. In Phase I, we will focus on demonstrating the viability of two of the key sub-systems: (1) testing a proprietary TDA catalyst in a micro-channel syngas-to-olefins reactor at small scale, and (2) refining a small scale polyethylene synthesis system that converts the range of products from the olefin synthesis process into polyethylene and other co-polymers. We will design a 5 kg/day polyethylene production plant, using lab data and performance specifications provided for existing systems such as the electro-chemical CO2 reduction to CO, hydrolysis for conversion of H2O to H2, and reformer technology for converting unreacted gases back to synthesis gas. Phase I will produce a detailed design of this system, including an estimate of the weight and volume.

Primary U.S. Work Locations and Key Partners



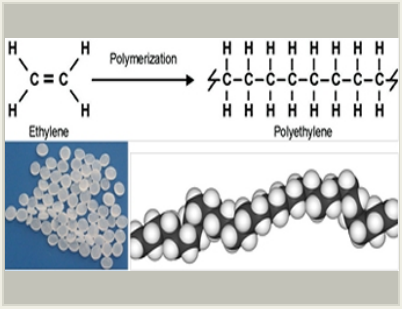


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Table of Contents

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Organizations Performing Work	Role	Type	Location
TDA Research, Inc.	Lead Organization	Industry	Wheat Ridge, Colorado
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Colorado	Texas

Project Transitions

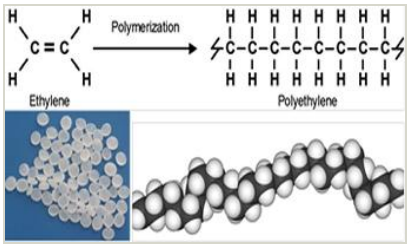
June 2016: Project Start

December 2016: Closed out

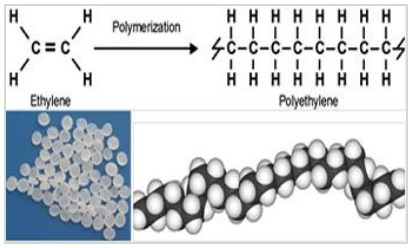
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140418)*

Images



Briefing Chart Image
Polyethylene Production from In-situ Resources in Microchannel Reactors, Phase I
(https://techport.nasa.gov/image/130665)



Final Summary Chart Image
Polyethylene Production from In-situ Resources in Microchannel Reactors, Phase I Project Image
(https://techport.nasa.gov/image/129702)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
TDA Research, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

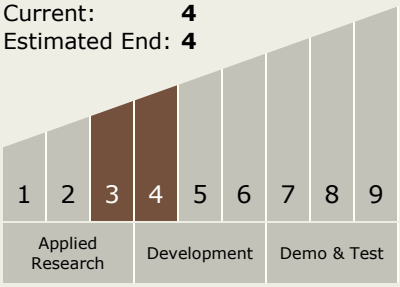
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Gokhan Alptekin

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Completed Technology Project (2016 - 2016)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.4 Resource Processing for Production of Manufacturing, Construction, and Energy Storage Feedstock Materials

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System